REMARKS

Claim 4 is amended to present Claim 4, which is indicated as being allowable, in independent form. The Applicants respectfully submit that no new matter has been added. It is believed that this Amendment is fully responsive to the Office Action dated July 27, 2009.

In the Final Office Action, Claims 1-3 and 5-8 were rejected under 35 U.S.C. §103(a) as being unpatentable over Selvan in his publication entitled "Synthesis of Tunable, Highly Luminescent QD-Glasses through Sol-Gel Processing" in view of Talapin in his publication entitled "Synthesis and surface modification of amino-stabilized CdSe, CdTe and InP nanocrystals". Reconsideration and removal of this rejection are respectfully requested in view of the following remarks.

Page 4, line 32 to page 5, line 8 of the present specification recites that ". . .an attempt has been made to disperse superfine particles in a glass matrix by a sol-gel process using a tetraalkoxysilane (Selvan). . . In this method, however, the superfine particles are insoluble in water, so usable sol-gel processes are limited and only gelled products can be obtained."

Page 9, lines 16-27 of the present specification recites "Semiconductor superfine particles that form a monodisperse system in water . . . are preferably used. Using such superfine particles allows the particles to form a monodisperse system in a solid matrix . . . by a common sol-gel process using water".

Further, in an Example of the present invention, superfine particles of cadmium telluride were manufactured in accordance with the method of Gao et al. In the present specification, it is recited that semiconductor superfine particles manufactured in accordance with the method of Gao et al. are capable of forming a monodisperse system in water (page 9, line 28 to page 10, line 6).

As is evident from these disclosures, preferably used in the present invention are semiconductor superfine partilces capable of forming a monodisperse system in water (hydrophilic) to produce a solid glass matrix. This allows for production of a solid glass fluorescent substance.

Selvan uses CdSe or CdSe/ZnS superfine particles (FIG. 2 etc.) The surface of each particle is hydrophobic, as each is coated with TOPO (trioctylphosphine oxide) and TOP (trioctylphosphine) (page 986, left column, lines 17-20). In Selvan, the particles are mixed with octylamine, which buffers pH of the sol-gel fluid, thereby increasing gelation kinetics (page 986, left column, lines 10-11 from the bottom).

Regarding the method of Selvan, the present specification recites on page 4, line 32 to page 5, line 8 that in the method of Selvan, "... the superfine particles are insoluble in water, so usable sol-gel processes are limited and only gelled products can be obtained". As recited, the particles obtained according to Selvan are not solids. The following more specifically explains why the method of Selvan cannot produce solid particles.

The title of Selvan is "Synthesis of Tunable, Highly Luminescent QD-Glasses Through Sol-Gel Processing". However, Selvan is completely silent about obtaining a solid matrix. When

producing a solid, the volume is inevitably reduced during the dehydration condensation reaction. Therefore, the conditions for fluorescence-spectrum measurement differ from those of solution cell measurement. For this reason, it is not possible to simply compare the fluorescence spectrum of a sold and the fluorescence spectrum of a solution. However, according to FIG. 1b in Selvan, the fluorescence intensity is measured continuously for 12 hours from the beginning of the reaction, and it is recited that "the emission decreases over some 12 hours, then stabilizes". According to this description, it is not likely that the fluid became a solid during the process.

The Abstract and FIG. 3 of Selvan show a photo of phosphors in lidded containers.

The caption of FIG. 3 discloses that the gels were four days old.

Selvan does not mention the amount of octylamine used for the synthesis. However, octylamine is a liquid having a high boiling point (175 to 177°C), and its vapor pressure is only about 6% at room temperature. Accordingly, it is difficult to remove water unless heating is performed.

It is respectfully submitted that these disclosures show that the product of Selvan is not a sol. Therefore, the product is not capable of maintaining its form against gravitational force (i.e., it is not a solid).

The Office Action states that the method of Selvan is the same as the method of Talapin, in which the surfaces of semiconductor superfine particles are modified by amines.

However, contrary to the Office Action statement, it appears that the TOP and TOPO on the

surfaces of the semiconductor superfine particles of Selvan can hardly be substituted for octylamine. This is evident from the fact that, although the description in section 2.6 of Talapin states that substitution with alkylamine (DDA (dodecylamine) in Talapin) requires heating at 100°C for 24 hours, Selvan is silent about such heating. As such, the method of Selvan is completely different from the method of Talapin, and it is thus impossible to combine Talapin and Selvan.

Even if Selvan and Talapin are combinable and the superfine particles of Talapin can be produced by the method of Selvan, it is obvious that the luminous efficiency of the obtained particles falls below the range "3% or greater" specified in the present invention. Therefore, the product will not have the characteristics of the phosphor of Claim 1 of the present invention. This is more specifically explained below.

In Talapin, the three semiconductor superfine particles CdSe, CdTe and InP are produced by mixing a primary amine having a high boiling point, such as DDA or the like, with TOP serving as a solvent. This method reduces size distribution, and produces micro-sized semiconductor superfine particles.

Among the three kinds of above-mentioned semiconductor superfine particles, the luminous efficiency of InP is below 1% at this stage (page 147, right column, line 7 from the bottom). Therefore, no further processes are performed.

CdSe and CdTe are modified to be water-dispersible by replacing the surfaces with mercaptoammonium salt (chloride of N, N-dimethyl-2-mercapto ethylammonium). However, as described in the beginning of section 2.5 on page 148 of Talapin, this process must be performed in

a nitrogen gas atmosphere, so as to prevent oxidation on the surfaces of the semiconductor superfine particles.

The surfaces of CdSe and CdTe are oxidized by being in contact with oxygen. According to their relative positions in the VI group semiconductor periodic table, the ease of oxidation is CdTe>CdSe>CdS.

In contrast, CdTe is synthesized in water in the Examples of the present invention, and an alkaline solution (pH: about 11) containing sodium hydrogen telluride, cadmium perchlorate and thioglycolic acid (TGA, HS-CH_2-COOH) as a surfactant is refluxed. It is known that TGA is decomposed to produce "S" when it is heated in an alkaline region. It is known that the produced S substitutes Te during the formation of CdTe superfine particles, thereby producing CdTe(S). This is shown in A.L. Rogach, *Materials Science and Engineering*, B69-70, 435(2000), N. Murase et al., *Nanoscale Res. Lett.*, 2: 230(2007), etc. (Enclosed)

Murase et al. discloses quantification of S. The presence of S prevents oxidation in the air, and maintains the luminous efficiency. Since CdTe of Talapin does not obtain S, it is oxidized in the air, and the luminance decreases. For this reason, conversion in water is performed in a nitrogen gas atmosphere in Talapin.

In contrast, the oxidation of CdSe proceeds more slowly than that of CdTe. However, as recited in Talapin, CdSe transferred to water was almost quenched (the last sentence of section 2.5 of Talapin). This is presumably because the bond with thiol generates a defect having a specific energy order on the surface of CdSe (last sentence of section 3.2 of Talapin).

Thus, among semiconductor superfine particles according to Talapin, the luminous efficiency of InP is originally less than 3%. Moreover, since CdTe oxidizes in the air and is quenched, it is very unlikely that CdTe has a luminous efficiency of 3% or greater in the air. Furthermore, CdSe is completely quenched when it is dispersed in water.

In conclusion it is respectfully submitted that none of InP, CdSe, and CdTe of Talapin can have a luminous efficiency of 3% or greater in the air. Therefore, the phosphor of the present invention cannot be produced by the method of Talapin.

Regarding the concentration and particle size, the Office Action states that a combination of the concentration of Selvan and the particle size of Talapin falls within the scope of the present invention.

However, since the particle size and concentration of semiconductor superfine particles are closely related, the concentration of Selvan and the particle size of Talapin cannot be readily combined without reasonable grounds.

When the method of Selvan is adopted, the particle size of the semiconductor superfine particles becomes large, falling out of the particle size range specified by Talapin. Thus, it is not possible to set the particle size of the particles produced by the method of Selvan within the range of Talapin. Moreover, the semiconductor superfine particles produced by the method of Selvan do not meet the concentration range specified by Claim 1 of the present invention. This is more specifically explained below.

Selvan uses a green/red light-emitting CdSe superfine particles coated by ZnS. Bawendi et

al., *Journal of Physical Chemistry*, B., vol. 101, p. 9463 (1997) FIG. 2 and its caption (page 9465) clearly indicate that the diameter of the semiconductor superfine particles of Selvan is not less than 3 nm. FIG. 2 of Bawendi et al. is a drawing showing the particle size and luminous wavelength of a CdSe nanoparticle having a ZnS shell. The red light corresponds to "d", and the green light corresponds to "b". Even for the smaller of "b" and "d", the diameter of the core CdSe nanoparticle is 42Å. On the outside of this CdSe is a ZnS shell having a thickness of 4Å or greater. As such, the diameter of the semiconductor nanoparticles produced by the method of Selvan is not less than 4.6 nm. Therefore, it is impossible to employ the particle sizes ranging from 1.2 to 2.5 nm according to Talapin to the semiconductor nanoparticles produced by the method of Selvan.

Moreover, Selvan states that the upper limit of the volume fraction is 0.1 vol.% (page 987, left column, lines 5-6 of the Summary section). The specification of the present invention states that 0.1 vol.% is about $1x10^{-4}$ mol/L when the particle size is 3 nm.

Since the particle diameter is greater than 3 nm in Selvan, the concentration becomes less than $1x\ 10^{-4}$ mol/L. Therefore, Selvan does not meet the range "$5x10^{-4}$ to $1x10^{-2}$ mol/L" specified by Claim 1 of the present invention.

In view of the above remarks, removal of this rejection is respectfully requested.

COMMENTS

On page 5, line 2 of the Office Action, it is stated that "a clarification of the claims might be appropriate". The Applicant interprets this statement as a request for an explanation of the phrase

"substantially monodispersed" in Claim 5. This phrase assumes a case in which, if the particles are aggregated, the emission spectrum width may increase, thereby causing the peak to be shifted to the long wavelength side. The specification of the present invention briefly describes this on page 14, lines 24-27.

Also, on page 4, lines 3-5 of the Office Action, it states that "[t]he size of particles taught by Selvan is from 1.2-2.5 nm. Talapin teaches a concentration up to 0.1 vol.%" (see conclusion). It should be noted that in this phrase, "Selvan" and "Talapin" are reversed.

In view of the above remarks, Claims 1-3, and 5-8, as well as Claim 4, are believed to be patentable and in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the Applicants' undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, the Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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Enclosure: Petition for Extension of Time
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